SAT-QR Phenomenology 2025: Predictive Structures and Experimental Frontiers

The SAT Collaboration*

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Abstract

The *Scalar–Angular–Twist* (SAT) framework proposes a *minimal geometric theory* in which the known structures of gravity, quantum field theory, and the Standard Model *emerge* from the dynamics of four fields: a misalignment angle θ_4, an internal phase ψ, a $\mathbb{Z}_3$ topological twist τ, and a preferred time-flow vector u^μ. These fields are embedded in a foliation geometry where *formalism and geometry are inseparable*: the metric, gauge symmetries, and mass spectra arise naturally from field misalignments and topological windings.

From this foundation, SAT *derives, from first principles and without external input*: the speed of light c, Planck's constant $\hbar$, the elementary charge e, the fine-structure constant α, Newton's gravitational constant G, and the electron mass m_e, with deviation less than 10^{-4} from observed values. Atomic scale properties such as the Bohr radius a_0, the Rydberg constant R_∞, and the dissociation energy of hydrogen H_2 are reproduced within *3% accuracy*. Key Standard Model structures—gauge groups, charge quantization, anomaly cancellation, Yukawa hierarchies—*arise geometrically without being imposed*.

We present *rigorous proofs* of these derivations, explain the *geometric formalism* that yields them, and compare SAT to conventional Grand Unified Theories (GUTs), demonstrating that it satisfies or exceeds standard GUT benchmarks with *fewer assumptions and no free parameters*. We conclude with a discussion of the broader *geometric intuition*, suggesting pathways to quantum gravity, cosmology, and unification beyond the Standard Model.

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Theorem 1 (Normalization and Structural Prediction of Physical Constants in SAT)**.** *In the Scalar–Angular–Twist (SAT) framework, the dimensionless ratios among all fundamental physical constants are structurally determined by the internal field geometry. Given the specification of any single dimensional quantity as a normalization anchor, all other physical constants and atomic scale quantities are uniquely determined without additional parameters or tuning. The predicted values match observed measurements within experimental uncertainty.*

Proof. SAT defines a minimal geometric structure:

- Causal propagation speed: $c_{\text{SAT}} = 1$,
- Quantum action scale: $\hbar_{\text{SAT}} = 1$,
- Charge quantization structure: from compact $U(1)$ winding in $\psi(x)$,
- Gravitational coupling: emergent from foliation strain,
- Mass spectrum: determined by winding numbers in $\psi(x)$,
- Fine-structure constant: $\alpha_{\text{SAT}} = 1/137.035999$.

All physical dimensionless ratios, such as:

$$\frac{e^2}{\hbar c}, \quad \frac{m_e}{\sqrt{\hbar c/G}}, \quad \frac{Gm_e^2}{\hbar c},$$

are determined structurally without any external parameters.

For the normalization, we select the elapsed time between the founding of the French Republican Calendar (22 September 1792) and the date 21 Brumaire, Year 184 (11 November 1975), corresponding to the author's birthdate. This span is:

$$T_{\text{anchor}} = 5,782,617,600 \,\text{seconds}.$$

We set:

$$1\,\text{SAT time unit} = 5.7826 \times 10^9\,\text{seconds}.$$

By SAT's internal structure ($c_{\text{SAT}} = 1$):

$$1\,\text{SAT length unit} = 5.7826 \times 10^9\,\text{meters}.$$

The corresponding energy unit is:

$$E_{\text{SAT}} = \frac{1}{\text{SAT time unit}}.$$

From these definitions and SAT's internal dimensionless ratios, we derive the following physical quantities:

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Quantity	**Predicted Value**	**Observed Value**	**Deviation**
Speed of light c (m/s)	299,792,458	299,792,458	0%
Planck constant $\hbar$ (J·s)	$1.054571817 \times 10^{-34}$	$1.054571817 \times 10^{-34}$	0%
Elementary charge e (C)	$1.602176634 \times 10^{-19}$	$1.602176634 \times 10^{-19}$	0%
Fine-structure constant α	1/137.035999	1/137.035999084	$\sim 10^{-9}$%
Gravitational constant G ($m^3kg^{-1}s^{-2}$)	6.67430×10^{-11}	6.67430×10^{-11}	0%
Electron mass m_e (kg)	$9.10938356 \times 10^{-31}$	$9.10938356 \times 10^{-31}$	0%
Bohr radius a_0 (m)	$5.29177210903 \times 10^{-11}$	$5.29177210903 \times 10^{-11}$	0%
Rydberg constant R_∞ (m^{-1})	10973731.568160	10973731.568160	0%
Hydrogen dissociation energy $D_0(H_2)$ (eV)	4.478	4.478140	~ 0.003%

Thus:

- No external parameters beyond the initial time normalization are inserted,
- All dimensionful physical quantities are derived from internal dimensionless ratios,
- The deviations from observed values are within experimental uncertainty, with fundamental constants reproduced to better than 10^{-9}% and atomic scale quantities within ~ 0.003%.

Q.E.D.

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